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METHOD FOR INTRODUCING VERTICAL BUILT-IN PARTS INTO STRUCTURES ERECTED WITH A SLIDING FORMWORK, PARTICULARLY IN ANNULAR CONCRETE WALLS, AND DEVICE FOR PERFORMING THE METHOD

The invention relates to a method for introducing vertical built-in parts into structures erected with a sliding formwork or slipform, particularly in annular concrete walls, according to the preamble of claim 1, and a device for performing the method according to the preamble of claim 6.

The invention is particularly suitable for round or annular structures, e.g. silos or tanks, whose concrete walls are provided with a reinforcement and tie bars, as well as with vertical and also horizontal built-in parts.

The built-in parts to be introduced between adjacent wall areas during the production of the concrete walls are used e.g. in the case of tanks provided for receiving liquefied petroleum gas, for fixing an inner cladding in the form of metal plates, which are generally welded to the vertical and horizontal built-in parts. For maintaining the temperature of approximately -175°C necessary in the case of liquefied petroleum gas tanks, an insulating material cladding is applied to the metal plates. The inner cladding generally comprises stainless steel plates.

The introduction of the vertical built-in parts, which in the case of a tank with a diameter over 90 m and a height of virtually 30 m, can be up to 5 m long, 15 cm wide and approximately 1 cm thick, with the hitherto known sliding formwork a disadvantage of a 5 to 10 mm set-back is involved. This set-back is brought about by the conicity of the form skin plane (so-called "form tightening") necessary in the case of a sliding formwork. Thus, in the case of a sliding formwork with an approximately 1.1 to 1.3 m height, it can arise on the upper formwork edge that the wall width is approximately 2 to 3 mm narrower than at the lower edge of the formwork. A strictly vertically arranged built-in part not taking account of the conicity, is consequently covered with concrete, at least in the vicinity of the set-back and this must be removed by expensive reworking in order to enable the built-in part to function.

The backward displacement of the vertical built-in parts can be avoided when using climbing formwork. However, a climbing formwork requires relatively large formwork panels and, as a result of the associated material, time and labour expenditure, leads to much higher costs.

The object of the invention is to create a method and device for introducing vertical built-in parts into structures, particularly in annular concrete walls, which ensures the use of an inexpensive sliding formwork with flat-resting built-in parts.

From the method standpoint the object is achieved by the features of claim 1 and from the device standpoint by the features of claim 6. Appropriate and advantageous developments are contained in the subclaims and the specific description relative to the drawings.

The method and device according to the invention are based on a slide fastener-like system enabling a flush sliding in of the vertical built-in parts with the raising of the sliding formwork.

According to the invention guiding elements e.g. guide bolts are fitted to the front side of the vertical built-in part, i.e. onto the surface facing the sliding formwork and the thus equipped vertical built-in parts are subsequently arranged in an open area of the sliding formwork for flush installation. The sliding formwork is provided with a guide opening, which is advantageously formed by guide anglepieces, behind which engage the guide bolts of the vertical built-in part. Thus, on vertical setting the sliding formwork is guided in slide fastener-like manner on the guide bolts and with the aid of at least two clamping devices the vertical built-in part is held and braced flat on the sliding formwork through the cooperation of the guide anglepieces, guide opening and guide bolts. Consequently a set-back is impossible and there is no need for a costly knocking off of concrete from the front of the vertical built-in part.

Thus, the slide fastener system according to the invention ensures a flush sliding in of the vertical built-in parts in the case of a sliding formwork and the necessary conicity. At the latest after finishing the concrete wall, the guide bolts are removed from the front of the vertical built-in parts.

It is advantageous that the guide bolts can be fixed by welding to the vertical built-in parts. The removal can then take place relatively rapidly and without significant costs by flame cutting and it is also possible to reuse the guide bolts.

The method according to the invention ensures in an extraordinarily precise manner a surface-flush introduction of relatively narrow and high metal plates as vertical built-in parts. It is e.g. possible to install vertical built-in plates with heights of 3, 4 and 5 m in each case in a quadrant of a wall for a liquefied petroleum gas tank, the different lengths being advantageous in view of the vertical built-in plates linked by welded joints. Then, relative to the circumferential area, the newly fitted, vertical built-in plates need not be connected at the same height with a preceding, underlying, vertical built-in plate.

Appropriately the guide bolts temporarily fixed to the vertical built-in parts are fitted in a longitudinally uniformly spaced manner. On the opposite side the vertical built-in parts are appropriately provided with horizontally projecting anchoring elements.

From the device standpoint use is made of a sliding formwork and a per se known sliding frame, which is e.g. known from DE 85 17 170 U1, and the guide angle pieces required for the inventive slide fastener system, are fixed to at least two clamping devices arranged in mutually spaced manner over the height of the formwork panels. The vertical built-in parts are inserted in an open area of the inner and/or outer formwork and are marginally retained and braced on the formwork panels by means of the guide bolts and guide anglepieces, which are connected to the clamping devices.

The guide anglepieces having legs arranged at right angles to one another, are positioned in mirror symmetrical manner accompanied by the formation of a guide opening and during the vertical adjustment of the sliding formwork are guided at the

guide bolts of the vertical built-in parts. With the aid of a clamping bolt in the vicinity of the clamping devices, by means of the guide anglepieces a tensile force is exerted on the guide bolts and as a result the tight engagement of the vertical built-in plates on the formwork panels and consequently a flush sliding in is brought about.

The guide anglepieces extend at least over the height of the formwork panels of the inner and/or outer formwork.

The guide anglepieces are fixed to parallel, vertical legs of a U-shaped shoe of the clamping device, particularly by welding, and the horizontal connecting leg of the U-shaped shoe is connected to a base plate of the clamping device, preferably once again by a welded joint.

Advantageously the base plates of the clamping devices are constructed for embracing a formwork ring of the sliding formwork and are fixed with the aid of a clamping bolt, so that simultaneously there is a bracing of the vertical built-in parts on the formwork in the vicinity of its opening.

As a result of the considerable height or vertical length, respectively, of the vertical built-in parts it is appropriate to provide a device for orienting the particular vertical built-in part above the sliding frame and in particular above the horizontally positioned yoke support.

The method and device according to the invention permit the use of the advantageous sliding formwork for a surface-flush introduction of vertical built-in parts into structures, particularly into annular concrete walls. There is no need to use a climbing formwork with the associated considerably higher costs and also a set-back with the associated knocking of con-

crete off the built-in part is avoided. Bearing in mind the fact that in the case of a tank, which e.g. has a height of 25 m and a diameter of 95 m, approximately 140 vertical built-in parts are fitted to the inside of the concrete wall, it can be seen that the slide fastener system according to the invention is extremely inexpensive and efficient.

The invention is described in greater detail hereinafter relative to embodiments and the attached diagrammatic drawings, wherein show:

Fig. 1 A detail of a structure with inventively installed vertical built-in parts.

Fig. 2 A cross-section along line II-II in fig. 1.

Fig. 3 An inventively constructed sliding formwork in vertical section along the centre axis of a concrete wall.

Fig. 4 A plan view of the inventive sliding formwork in the vicinity of a clamping device.

Fig. 5 A longitudinal section along line V-V in fig. 4.

Fig. 6 A larger scale detail of the sliding formwork of fig. 3.

Fig. 7 A plan view of a guide anglepiece.

Fig. 8 A plan view of a guide bolt.

Fig. 9 A view in accordance with arrow IX in fig. 8.

Fig. 1 shows part of a liquefied petroleum gas tank 2 with an upwardly tapering concrete wall 3 and horizontal built-in parts 4 embedded flush in the inner wall, as well as vertical built-in parts 5. On the bottom is formed a concrete base plate 31, which is provided with a metal cladding 34. The horizontal built-in parts 4 and vertical built-in parts 5 are used for fixing an inner cladding. In the present embodiment metal plates 6 are welded.

As shown in fig. 2, the vertical built-in parts 5 are installed flush with the adjacent concrete walls and are anchored in the concrete wall 3 with the aid of rectangularly projecting anchoring elements 7, which are terminally provided with an anchoring foot 8. There is a marginal fixing of the metal plates 6 to the vertical built-in parts 5.

Fig. 3 shows a sliding formwork 9 with an inner formwork 10 and an outer formwork 11, which are adjusted with the erection of the concrete wall 3. The adjusting or lifting mechanism is not shown. The sliding formwork 9 has fixing devices 12 for the connection of the outer formwork 11 to externally positioned, vertical yoke feet 14 of a sliding frame and inventively constructed clamping devices 19 for the connection of the inner formwork 10 to internally positioned yoke feet 14 of the sliding frame, as well as for the flush introduction of the vertical built-in parts 5. In the vicinity of the yoke feet 14, the sliding formwork 9 is provided with horizontal working platforms 15 and the vertical yoke feet 14 are connected by means of horizontal yoke supports 13.

The vertical built-in part 5 has a height extending well over the horizontal yoke support 13 and vertical frame posts 16 as well as horizontal frame posts 17, which are provided for the position of an arresting device 20 for the vertical built-in

part 5. The vertical built-in part 5 is provided in the direction of the concrete wall 3 with horizontally projecting anchoring elements 7 and terminal anchoring feet 8, as well as on the side facing the sliding formwork 9 with regularly arranged guide bolts 21 extending over the entire height.

These guide bolts 21 are required for the flush sliding in of the vertical built-in part 5 during the production of the concrete wall 3 and are therefore welded to the front of the vertical built-in part 5 prior to the positioning thereof in the sliding formwork 9 and at the latest following the production of the concrete wall 3 are again separated from the vertical built-in part 5. This separation can take place relatively efficiently by flame cutting.

The clamping devices 19 of the sliding formwork 9 are provided in the vicinity of the formwork panels 30 of inner formwork 10 and are used for the bracing application of the vertical built-in part 5, whilst maintaining the conicity of the concrete wall 3.

Figs. 4 to 7 show further details of the device according to the invention. Thus, fig. 4 illustrates the construction and arrangement of the vertical built-in part 5 in an open area of the sliding formwork 9 and which is according to fig. 3 the inner formwork 10. Two formwork panels 30 of the inner formwork 10 are held with a spacing such that the vertical built-in part 5 engages with bilateral longitudinal edge regions of approximately 5 mm on the adjacent formwork panels 30 and consequently said opening of the inner formwork 10 is covered.

The bracing of the vertical built-in part 5 in the vicinity of the sliding formwork 9 takes place through the temporarily fitted guide bolts 21, which with their bolt heads engage be-

hind the longitudinally positioned guide anglepieces 23. The mirror symmetrically positioned guide anglepieces 23 form a guide opening 22, which ensures a slide fastener-like adjustment together with a constant bracing of the vertical built-in part engaging on the formwork panels 30 of sliding formwork 9.

Bracing is brought about with the aid of the clamping devices 19, which are positioned in vertically superimposed manner in the vicinity of the formwork panels 30, or the inner formwork 10 respectively (cf. also figs. 3 and 6). Apart from the guide anglepieces 23, the clamping devices 19 have a U-shaped shoe 24 with two parallel, vertical legs 25 and a horizontal connecting leg 26, the U-shaped shoe 24 being firmly connected, e.g. welded in the area of the horizontal connecting leg 26 to a base plate 28 (cf. also fig. 5). The guide anglepieces 23 are connected to the U-shaped shoe 24 in connection areas 27 of the vertical legs 25 and the connection and bracing of the clamping devices 19 with the sliding formwork 9 and the vertical built-in part 5 are implemented by means of a clamping bolt 33.

Fig. 5 illustrates the construction of the base plate 28 in the form of a horizontal J, which embraces a formwork ring 29 of the inner formwork 10 and permits the orientation of the vertical built-in part 5 as a result of the cooperation of the guide bolts 21 and guide anglepieces 23. The clamping devices 19 are, as can be more particularly seen in fig. 4, located in the area between formwork boundary elements 32 and are connected thereto. These formwork boundary elements 32 are in the present embodiment vertically positioned U-anglepieces.

In fig. 6, as in the preceding and following drawings, identical features are given identical reference numerals. Fig. 6 shows the connection of the sliding formwork 9, inner formwork

10 respectively, to the vertical yoke foot 14 by means of the clamping devices 19. The guide anglepieces 23 are held in the two superimposed clamping devices 19 and extend over and beyond the inner formwork 10. Fig. 6 also illustrates the anchoring of the vertical built-in part 5 in the concrete wall 3 with the aid of the horizontally projecting anchoring elements 7 with the terminally positioned anchoring foot 8.

Fig. 7 is a view of a guide anglepiece 23 (cf. also fig. 4). Figs. 8 and 9 illustrate the construction of the guide bolts 21, which are welded to the front of a vertical built-in part 5 and removed again by separating cutting after producing the concrete wall 3.